Perching Behaviour and Disturbance during Sleep in Three Hybrids of Broiler Chicken (*Gallus gallus domesticus*)

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Maya Wedin

Uppsala 2016

Ethology and Animal Welfare – Bachelor's programme

Pic. 1 (Yngvesson, 2015).

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I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

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ABSTRACT

The aim of broiler chicken production is to breed chickens with high growth rate and muscle/bone ratio. However, this selection has affected the physiology of the broilers and as a result broilers display a physique that inhibits them in executing behaviours that they are motivated to perform. Hybrids of reduced growth rate seem to be less impeded by their physique than faster growing hybrids.

Perching is a natural behaviour for chickens and sleeping undisturbed is important for the welfare of the individual. When sleeping on the floor, broilers risk being disturbed as individuals that are awake might step on them, resulting in reduced welfare for the startled chicken. EU-organic regulations state that the choice of hybrid in EU-organic production should prevent animal suffering. It is therefore important to study how different hybrids vary in perching behaviour and disturbance of sleeping chickens. Hence, this study aimed to compare perching behaviour as well as disturbance during sleep in three hybrids of different growth rate.

Three hybrids differing in growth rate were used in this study; Ross 308, Rowan Ranger and Hubbard CYJA57, 100 birds per hybrid. The hybrids were housed together in one flock (stocking: 1.84 chickens/m^2 or 8.19kg/m^2 at slaughter) under EU-organic conditions and provided with perches of three heights (20, 40 and 70 cm). There was always plenty of perch space during the study. Observations were performed by group scan during photophase as well as scotophase and by focal bird observation. Significance was calculated with Chi square test, Yates correlation Chi square test or Student's T-test.

Ross chickens perched significantly less than Hubbards and Rowan Rangers during photophase and scotophase ($P<0.001$) even though there was no significant difference in sleeping behaviour during photophase ($P>0.1$). Ross utilized only the lowest perches while the other hybrids perched on all heights.

Disturbance of sleeping chickens was not significantly different between hybrids but Hubbards tended to disturb sleeping birds more than Ross chickens did. Furthermore, males were significantly more prone to perform disturbance than females ($P<0.05$). Hubbards were at greater risk than Ross chickens to be recipients of disturbance ($P<0.05$) and Rowan Rangers showed a tendency to receive more disturbance than Ross. Being the recipient of disturbance was not affected by gender.

As the Ross chickens perched to a lesser extent than the other two hybrids, and as they only perched on the lowest perches, it is probable that they experienced a reduced welfare in comparison to the other hybrids. However, Ross chickens were less disturbed during sleep which indicates a higher welfare in this aspect.

Due to the results in the present study this paper argues that, in order to comply with EU-organic regulations, Hubbard CYJA57 or Rowan Ranger should be favoured over Ross 308 as these hybrids attain a higher welfare when compared to Ross.

1. INTRODUCTION

1.1 Background

Perching is a highly motivated behaviour in the red jungle fowl (*Gallus gallus*) (Collias & Collias, 1967; Arshad & Zakaria, 2009) as well as the domestic chicken (*Gallus gallus domesticus*) (Blokhuis, 1984; Olsson & Keeling, 2000; Olsson & Keeling, 2002), but commercially reared broilers in Sweden are not provided with perches and therefore they cannot perform this behaviour. However, when broilers are provided with perches, the usage is low (Su *et al.,* 2000; Pettit-Riley & Estevez, 2001) due to the size and physical abilities of the chickens (Bokkers & Koene, 2003; Nicol, 2015).

Young chickens sleep most of their time (Malleau *et al.,* 2007) and under natural conditions they sleep either under their mother's wing (Collias & Collias, 1967; Edgar *et al.,* 2016) or perched in a tree (Collias & Collias, 1967). As no mother or perch is provided in commercial broiler production, the chickens sleep on the floor. However, there they risk being disturbed by other chickens stepping on them. Disturbance during sleep is not well studied in broilers. Furthermore, there is scant research studying how disturbance during sleep and perching differ between hybrids selected for different growth rates. Therefore this study aims to investigate how hybrids differing in growth rate vary in perching and sleeping behaviour. Furthermore it will discuss how these differences might affect the welfare of chickens belonging to the different strains. The results of this study can be used as a guideline when choosing which hybrid to house when striving to uphold broiler welfare in commercial production. It can furthermore function as a source of information when modifying regulations for EU-organic and KRAV housing.

1.1.1 Production and Consumption

The consumption of meat in Sweden is steadily increasing. During the last thirty years consumption increased with 46 % (Statistiska Centralbyrån, 2013). While cow (*Bos Taurus*) and pig (*Sus scrofa*) production has declined during the last 15 years broiler slaughter has increased by 37 % which has led to a total increase of slaughtered animals of 34 % (comparing Jordbruksverket, 2003 with Jordbruksverket, 2016), and during 2015 broilers made up 93 % of all individuals slaughtered for food in Sweden. This is because each slaughtered cow or pig results in an average of 310 kg or 91 kg meat, respectively, while each broiler resulted in 1.4 kg of meat. This means that 217 chickens need to be slaughtered to produce the same amount of meat that a single cow produces. This also means that changes in regulations affecting broiler welfare have the potential to increase welfare for over ninety million individuals per year in Sweden alone (calculations and figures from Jordbruksverket, 2016).

1.2 Housing

There is much consensus within the Swedish broiler production and producers differ very little from each other (Berg & Algers, 2004). There are two main kinds of production; conventional and EU-organic or KRAV, where EU-organic and KRAV emphasize animal welfare (See 1.2.2 EU-Organic Production and 1.2.3 KRAV Production). Even though this production is expanding fast it is still very rare as it was equivalent to only 0.1 % of all broiler production in Sweden during 2013 (Jordbruksverket, 2013). Svensk Fågel is an

association that includes 99 % of all Swedish broiler farmers (Svensk Fågel, 2016c) and the rearing methods applied within the association are rather homogenous which means that they set the standard for how broilers are commonly reared in Sweden.

1.2.1 Conventional Housing

Typically, the chickens arrive at the farm directly after hatching (Svensk Fågel, 2016c). Most producers house 20 000 – 120 000 individuals separated in several groups (Svensk Fågel, 2016c). The chickens are provided with feed and water *ad libitum* (Svensk Fågel, 2016c) and are kept on floor with wood shaving litter (7 kap 1 § Statens jordbruksverks föreskrifter och allmänna råd [SJVFS 2010:15] om djurhållning inom lantbruket m.m., saknr L 100) but have no access to perches as in Sweden this is a requirement only for laying hens (9 § Animal Welfare Ordinance [1988:539]). There are no requirements of furnishing (7 kap L100) which results in the pens being barren except for feed troughs, drinkers and chickens. Swedish broilers are slaughtered around day 35, weighing roughly 1.8 - 2.3 kg (Svensk Fågel, 2016b).

In Sweden the stocking density is limited to 20 kg of chicken per m^2 (7 kap 7 § L100), which amounts to approximately 10 chickens of slaughter weight (Svensk Fågel, 2016b). However, 98 % of Swedish broiler farmers (Svensk Fågel, 2016a) are affiliated with a specific animal welfare auditing program which requires the farmers to achieve high animal welfare in several aspects, for example foot health (Svensk Fågel, 2008), and in return the farmer is allowed to stock animals at up to 36 kg or approximately 17.5 chickens of slaughter weight per m^2 (7 kap 8 § L100). As a reference, Bokkers *et al.* (2011) have calculated that at approximately 39 kg per m^2 the animals are so compressed against each other that they alter their behaviours in order to take up less space, meaning that they cannot perform all motivated behaviours.

1.2.2 EU-Organic Production

In Sweden there are two main certifications that aim to increase the welfare in animal production. These are EU-organic, which is regulated by the European Union and is the official organic certification in all the member states of the European Union; and KRAV, which is a Swedish certification which includes all EU-organic legislation as well as their own regulations.

The EU-organic legislation states that one single housing group of broilers should not exceed 4 800 individuals and that each building should not house more than 16 000 chickens (Article 12.3.e-f in Commission Regulation [EC] No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation [EC] No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control[1]). In conventional production no limit is set to group size in each house. Furthermore, in EU-organic housing chickens are required to be at least 81 days old at slaughter if they are not from a slow-growing strain (Article 12.5 in Regulation [EC] No 889/2008) and they need access to outside pasture at least one third of their life (Article 14.5 in Regulation [EC] No 889/2008). The EU-organic legislation also states that the selection of the housed breed should aspire to prevent animal suffering (Article

[1] JEU L 3, 18.9.2008, s.10, CELEX 32008R0250

14.1.c.iv in Council Regulation [EC] No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation [EEC] No 2092/91[2]; Article 8.1 in Regulation [EC] No 889/2008) and that the housing should fulfil the behavioural needs of the species (Article 10.3 in Regulation [EC] No 889/2008) as well as provide free access to roughage (Article 20.3 in Regulation [EC] No 889/2008) and at least four square meters of pasture per kept chicken (Annex III.2 in Regulation [EC] No 889/2008).

1.2.3 KRAV Production

The KRAV certificate requires that all EU-organic legislations are met and it also adds the requirement that the broilers should have access to items to jump up on (KRAV legislation 5.5.4.7, KRAV, 2016) and that the pastures are furnished with shelters for the chickens (KRAV legislation 5.5.3.3, KRAV, 2016). It also requires more access to the outdoors than the EU-organic legislation does (KRAV legislation 5.5.3.1, KRAV, 2016). Furthermore the specific Swedish animal welfare auditing program that allows for a stocking of 36 kg of chickens per m^2 is not sanctioned in the KRAV legislation, hence the stocking density is not allowed to exceed 20 kg per m^2 (KRAV legislation 5.5.4.1, KRAV, 2016).

1.3 Variation of Hybrids in the Industry

Sweden does not keep its own breeders of broilers (Svensk Fågel, 2016c). Instead breeding birds, so called Grand Parents, are brought in from England and the USA and these are allowed to breed in Sweden, resulting in a Parent generation which then conceives the desired broilers that are raised to slaughter (Svensk Fågel, 2016c). Since chickens can produce a large amount of offspring in short time it would suffice with about 200 Grand Parent birds to cover Sweden's broiler production (Svensk Fågel, 2016c) which is the reason for the Swedish industry to purchase Grand Parent birds instead of creating its own breeding scheme.

Since so few Grand Parents are required it is paramount that that these animals are of high quality. The market is today dominated by two companies, Ross and Cobb, which produce a large part of all commercially reared broilers in the world (Swedish Competition Authority, 2015). Since these two companies compete for customers they constantly try to breed birds that are more fast growing, more muscular, and more efficient in feed conversion (Rauw *et al.*, 1998; Arthur & Albers, 2003; Aviagen, 2016a; Cobb, 2016). For example, when comparing the Cobb 500 of 1980 with the same bird 2010, the animal weighs more than double (1.13 kg versus 2.5 kg) at 6 weeks while the feed conversion has increased with 25 % (2.4 versus 1.8 pounds of feed per pounds of weight gain) (Cobb, 2016). This intense breeding has resulted in fast growing birds that reach a slaughter weight of 2.5 kg at 42 days (Cobb, 2016) and therefore problems may arise when raising these birds according to the EU-organic regulations where slaughter is at day 81 at the earliest for fast growers (Article 12.5.a in Regulation [EC] No 889/2008). There also seem to be other issues that may indicate that they have reduced welfare (See section 1.4.2). Because of this more slow growing hybrids are now bred, for example the Rowan Ranger created by Ross' breeding company Aviagen (Aviagen, 2016b).

1.4 Behaviour

[2] JEU L 3, 20.7.2007, s. 10, CELEX 32007R0189

According to Swedish legislation animals are to be kept in a way that promotes their health and gives them the ability to express natural behaviours (4 § Animal Welfare Act, [1988:534]) and the design of the accommodation shall enable the animals to perform natural behaviours (1b § Animal Welfare Ordinance, [1988:539]). In order to achieve this it is important to know which behaviours are considered natural for the specific species and how these behaviours are performed.

1.4.1 Natural Behaviour

The red jungle fowl, the ancestor of the domestic chicken, has been shown to roost in trees during the night (Collias & Collias, 1967; Arshad & Zakaria, 2009) and this seems to be in order to avoid predation (Collias & Collias, 1967; Arshad & Zakaria, 2009; Schrader & Müller, 2009; Bestman *et al.*, 2011) as Collias & Collias (1967) have shown that the red jungle fowl hides in trees when threatened. Newberry *et al.* (2001) and Brendler *et al.* (2014) have both shown that laying hens prefer to perch at the highest perches available, and Schrader & Müller (2009) have shown that, although preferring perches to grids, laying hens actively choose to sleep on high grids rather than on low perches, indicating that hens highly value high resting places, preferably in the shape of a perch.

Perching is a highly motivated behaviour in red jungle fowls (Collias & Collias, 1967; Arshad & Zakaria, 2009) as well as in domesticated poultry (Blokhuis, 1984; Olsson & Keeling, 2000, 2002; Schrader & Müller, 2009) and it seems to be initiated by declining light (Kent *et al*., 1997). Olsson & Keeling (2002) demonstrated that layers are willing to work hard to get access to perches and Olsson & Keeling (2000) found indications of reduced welfare when denied access to perches. Arshad & Zakaria (2009) observed one single wild red jungle fowl rooster for 114 days and this rooster perched in trees every single night, indicating that roosting at night is a natural behaviour, and Collias & Collias (1967) also came to this conclusion when studying larger groups of wild red jungle fowl. The study of Arshad & Zakaria (2009) was conducted during an entire year which reduces the risk of bias because of seasonal behaviour which increases the reliability of the paper. The fact that they used a limited amount of references and that half of these were published more than thirty years prior to Arshad and Zakarias study does not affect the result although it would have increased the quality of the paper if they had referred to more recent studies. Red jungle fowl (Collias & Collias, 1967) and laying hens (Blokhuis, 1984; Cordiner & Savory, 2001) have both been shown to perch not only during the scotophase, i. e. the dark period of the day, but also during the photophase, the illuminated part of the day. Both Collias & Collias (1967) and Arshad & Zakaria (2009) have shown that young chicks as well as adults roost. It is therefore apparent that perching during the scotophase, and to a lesser extent during the photophase, is a natural behaviour for broilers as well as red jungle fowls.

Sleep is essential for most vertebrates, and especially so for juveniles (Malleau *et al.*, 2007). Since broilers reared commercially are slaughtered around day 35 (Svensk Fågel, 2016b), when the chickens have yet to reach sexual maturity which occurs at approximately six months (Bruggeman *et al.*, 1999; Wennström, 2005; Yang *et al.*, 2016) these birds are to be seen as juveniles the entire rearing period, functionally as well as behaviourally. They sleep for a large part of the day, although the time spent resting declines as the chicks mature (Malleau *et al.*, 2007).

Broilers sleep and perform other inactive behaviours during the entire day but these behaviours are most prominent during the scotophase, when the lighting in the stable is low (Malleau *et al.,* 2007; Alvino *et al.,* 2009a). This distinction becomes more pronounced as the chickens get older but it is also affected by how long the scotophase is and when it occurs (Malleau *et al.,* 2007). The natural behaviour of chickens reared by a mother hen is to shift between photophase and scotophase every forty minutes as the chicks need to hide under the hen to thermoregulate (Edgar *et al.,* 2016). Malleau *et al*. (2007) found that the chicks rested more during scotophase and were active more during photophase when these changed every 40 minutes than when the photophase was one continuous period during the day (19.5 h). This study tested each treatment eight times during the study which contributes to the reliability in the study.

However, more factors than just diurnal rhythm affects sleeping behaviour, another important factor is brightness. Alvino *et al.* (2009a) showed that broilers provided with 5 lx made a significantly smaller behavioural difference between photophase and scotophase than broilers provided with 50 or 200 lx. Alvino *et al.* (2009b) showed that the broilers provided with 200 lx during the photophase were more synchronized in their sleeping behaviour during the scotophase than the chickens provided with 50 or 5 lx. The synchronization resulted in the chickens sleeping longer but fewer bouts since there was a lower occurrence of interruptions from other chickens during sleep due to this synchronization. The authors believed that the interruptions during sleep negatively affected the welfare of the chickens and that the synchronization therefore was preferable.

1.4.2 Issues Affecting the Expression of Natural Behaviour

The domestic chicken, as well as its ancestor the red jungle fowl, has an innate motivation to perch (Collias & Collias, 1967; Blokhuis, 1984; Olsson & Keeling, 2000; Arshad & Zakaria, 2009), but in studies investigating perching in broilers usually only a small portion of the birds utilize the perches, for example 1-2 % for Su *et al.* (2000) and 2.6 % for Pettit-Riley & Estevez (2001). Hence, something is hindering the birds from perching. The problem might be that the wrong perches are provided since the shape (Bestman *et al.,* 2011; Chen *et al.,* 2014), height (Faure & Jones, 1982b; Newberry *et al*., 2001; Estevez *et al.,* 2002; Schrader & Müller, 2009), material (Faure & Jones, 1982a; Pickel *et al*., 2010; Chen *et al.,* 2014) and inclination (LeVan *et al.,* 2000; Mutaf *et al.,* 2006) of the perch affects frequency of utilization. However, another hindrance might be the physique of the birds themselves. It is known that leg problems are an occurring welfare problem for broilers; it occurs so often that one of the factors Bokkers & de Boer (2009) uses to evaluates broiler welfare is how much of a chicken's time budget it spends on walking. This problem originates from the intense growth broilers display and the high weight they reach at slaughter. Sanotra *et al.* (2003) discovered a negative correlation between weight and the ability to walk while Corr *et al*. (2003a) found significantly lower leg bone mass and lower amounts of ash and phosphorus in the legs of broilers fed *ad libitum* in comparison with birds kept on a restricted feeding scheme. As the bones do not mineralize, because energy is used in order to grow, the bones stay soft and cartilaginous which increases the risk of breaking when broilers are fed *ad libitum* (Corr *et al.,* 2003a). The birds fed *ad libitum* also displayed an altered walk with shorter strides, slower pace and longer contact with the ground, which seemed to stem from that the large breast muscles shifted the centre of the bird forward and thus impacting balance (Corr *et al.,* 2003b). Bokkers *et al.* (2007) made similar finds, as they demonstrated that broilers reared on 90 % of *ad libitum* feed were less inclined to walk to get a food reward than broilers reared on 50

%. However, the same result could not be found for birds reared on 75 and 50 % of *ad libitum* feed when the task to receive a food reward was to peck on an item (i. e. not related to walking) (Bokkers *et al.*, 2004) and it is therefore probable that it was not the motivation of the birds that was lacking in the first experiment but rather the physical ability. There is however a problem with Bokkers *et al.*'s (2004) study that might affect its credibility. The birds in the study were trained to peck on the item in order to receive a food treat but directly after each training session they were taken to their home pens and given their daily ration of feed (Bokkers *et al.*, 2004). The authors believed that this did not affect the results and referred to Ladewig *et al.* (2002) for support of this statement. However, Ladewig *et al.* (2002) did find significant differences in test results between groups that directly after testing were provided with the withheld resource for a short time versus a long time, which means that provision of the withheld resource directly after the test did affect test performance. Thereby the provision of feed directly after the tests in Bokkers *et al.* (2004) might have affected the results as well. However, all chickens in that study had the same treatment in that perspective and thereby would be affected in approximately the same way.

When a chicken sleeps on the floor, i.e. not perching, it runs a risk of being disturbed by other chickens that are awake. Since perching seems to be in order to avoid predation (Collias & Collias, 1967; Arshad & Zakaria, 2009; Schrader & Müller, 2009; Bestman *et al.*, 2011) it probably reduces chicken welfare to be startled by physical contact during sleep. Disturbance during sleep reduces quality of sleep in humans (Smith *et al.*, 2014) and "Comfort around resting" is a welfare sub criteria in the Welfare Quality® protocol (Welfare Quality®, 2009), and hence it is likely that broilers experience reduced sleeping quality when being disturbed during sleep. Alvino *et al.* (2009b) showed that disturbance of sleeping chickens occurred less when there was a large luminary distinction between scotophase and photophase. Furthermore, Hall (2001) concluded that there is a correlation between stocking density and occurrence of disturbance among chickens, and that this led to a decrease in chicken welfare when increasing stocking density.

Time budget in an individual chicken is affected by the individual's weight. Bokkers & Koene (2003) found that slow growing and fast growing strains differed significantly in frequency of the studied behaviours. When studied for 84 days the slow growing strain walked, scratched the litter and utilized perches significantly more than the fast growers while the fast growers sat more on the bedding and performed other behaviours more while sitting, for example feeding and drinking (Bokkers & Koene, 2003). This study also showed that from week five, the use of perches declined in the fast growing strain whereas the slow growing strain kept using the perches, which might be because of the negative correlation that was found between body weight and use of perches since the fast growing type gained weight faster (Bokkers & Koene, 2003). Other studies have also shown that perching behaviour in one of the most common hybrids, Ross 308, declines after week 4 (Bizeray *et al.*, 2002) to week 5 (Bailie & O'Connell, 2015).

2. AIM OF THE STUDY AND QUESTIONS

The objective of this study was to compare how the sleeping behaviour differed between three different hybrids of broiler chicken of different growth rate. Therefore the questions were as follows:

- Do any of the hybrids utilize perches more than the others?

- Is any hybrid overrepresented in performing or receiving disturbance from other chickens?
- Do the hybrids differ in weight or mortality?
- Does any other physiological difference (gender or weight) affect perching or disturbance behaviour?
- What do these differences indicate concerning the welfare of broilers belonging to the different hybrids?

3. MATERIALS AND METHOD

This study was performed as a part of a larger project investigating the productivity and welfare of different hybrids of broilers reared under EU-organic conditions.

3.1 Ethical Note

An ethical approval was obtained at the Gothenburg local Ethical Committee of the Swedish National Board for Laboratory Animals prior to commencing the study. To reduce risk of animal suffering due to the long rearing time, any bird having trouble walking or otherwise seeming to experience impaired welfare was euthanized. Birds were first stunned by a stroke to the back of the head after which euthanasia was performed by neck dislocation.

3.2 Chickens

Broilers of three hybrids differing in growth rate were acquired; Ross 308 (fast grower), Rowan Ranger (medium grower) and Hubbard CYJA57 (Color Yield x JA57) (slow grower) (100 birds of each hybrid). All parent birds of the chickens in the experiment were 45 to 47 weeks of age when eggs were collected. The Hubbard chicks were hatched at the research facility while Ross and Rowan Ranger chicks were brought in from a hatchery at day 1, however all chicks were hatched at the same day. Slaughter was at day 82. Each chicken was marked with a wing tag in each wing at day 4 to allow individual identification. At day 7 each bird was colour-marked to allow visual hybrid separation.

3.3 Housing

The experiment was conducted at a research facility in Lidköping, Sweden, between November and January. Day 0-4 the hybrids were kept separately in round pens with *ad libitum* access to water and an organic commercial broiler starter feed. Temperature was kept at 33 °C and litter was made of wood shavings. At day 4 all hybrids were mixed in a single rectangular pen (20 x 7.5 m) with access to perches, as well as *ad libitum* water and organic broiler feed. Due to the Swedish winter the chickens did not have access to pasture but were instead provided with Lucerne straw (4-5 cm long) as roughage in accordance with Article 14.7 in Regulation (EC) no 889/2008. At start 2 kg roughage was given to the chickens per day and this was steadily increased to 6 kg per day. At slaughter the stocking was 8.19 kg per m^2 (1.84 birds per m^2). The housing provided daylight from three sides during the bright hours of the day. The stable had an artificial photophase between 05.00-23.00 and a scotophase between 23.00-05.00. The temperature of the stable was 32 °C at day 4 and was steadily decreased to 23 °C at day 24. Thereafter ventilation was increased

which led to the indoor temperature being 15-20 °C depending on the outside temperature. Due to the cold three heating lamps were provided to the chickens throughout the entire rearing period. Litter was constituted of wood shavings.

Perches were designed as follows: three A-shaped wooden supports were connected with six horizontal wooden laths, thus allowing the chickens to perch on the horizontal laths at three different heights; 20, 40 and 70 cm; with 15 cm per housed chicken and height to perch on (Fig. 1). During the entire experiment there was never a shortage of space to perch on at any height. Five of these contraptions were set in a straight line through the centre of the stable. The horizontal laths were rectangular with a circumference of 2.5 x 2.5 cm. No ramps were provided.

Fig. 1. Perching contraption used in the present study (Wedin, 2015).

3.4 Observational Methods

Behaviour in all observations was recorded according to definition (Tab. 1). Prior to each observation the observer sat in the stable to habituate the chickens to her presence. No fearfulness was ever noted from the chickens regarding the observer, indicating that they were not affected by the observer's presence. As perching seems to decline with increasing age (Bizeray *et al.*, 2002; Bailie & O'Connell, 2015), the majority of the observations were performed during the late part of rearing (day≥60).

Tab. 1. Ethogram of the observed behaviours in the present study.

Behaviour	Definition
Perch	Chicken sits still on perch
Sleep	Chicken holds head in a low posture with eyes closed, under the wing, or rests it on the bedding
Lie down	The breast of the chicken touches the bedding
Preform disturbance	Other chicken abandons sleep or lie down position due to physical contact initiated by observed chicken
Receive disturbance	Chicken abandons sleep or lie down position due to physical contact initiated by other chicken

3.4.1 Photophase Group Scan

A group scan was conducted in a 2 x 2 m square in the pen with ten minutes of 0-1 registration of the chickens within the square. This observation was repeated in ten different locations in the stable per observational day on day 61, 76 and 80. Due to the method the number of chickens in each square varied as chickens could move freely within

the pen and leave or enter the square at any time. Perching and sleeping was recorded with this method.

3.4.2 Scotophase Group Scan

A group scan of all visible chickens was performed on day 63, 70 and 77, where number of chickens of each hybrid on each height was counted. Scan was performed fifteen minutes after lights out by observation through the stable windows so as to not disturb the birds unnecessarily. These scans were performed on different days than the photophase scan in order to reduce bias. Due to method modification no height data was collected during day 63. As this test was carried out during the night it was not possible to distinguish between Rowan Ranger and Hubbard chickens and these were therefore joined as a single group in the results. Additionally, it was not possible to distinguish if the chickens were asleep or awake. Perching and height of perch was recorded.

3.4.3 Photophase Focal Observation

A total of 30 chickens; 10 from each hybrid, were observed using focal observation on day 45, 61 and 80. Chickens were chosen at random. Focal birds were marked more thoroughly than other birds to allow recognition. Each chicken was observed with continuous registration for 10 minutes per observation and on 3 different occasions. Two focal birds, both Ross, died during the experiment and these were replaced with other randomly chosen chickens of the same breed. All behaviours were recorded with this method.

3.4.4 Weight

Animals were weighed at day 5, 12, 20, 27, 34, 40, 48, 55, 69, 75 and 82 except for Rowan Rangers which were weighed at day 7 instead of day 5. Chickens were weighed individually.

3.4.5 Gender

Gender was assessed at slaughter and birds that died prior to slaughter were not sexed.

3.4.6 Mortality

Mortality was assessed once daily. Autopsies were yet to be performed at time of writing so reason of death was not known.

3.5 Statistical Methods

Microsoft Excel was used to calculate Standard deviations and these were calculated on population rather than sample. P-values were calculated by hand with a Chi square (χ^2) test with one degree of freedom when $e>5$. When $e<5$ calculations were performed with Yates correlation Chi square test with one degree of freedom. When there occurred differences in group size (Tab. 3; Tab. 4) these were eliminated with the formula

$o = (n_{H1} / tot_{H1}) \times tot_{H2}$

where o = calculated value used as observed value in the Chi square test, n_{H1} = number of birds in hybrid 1 that performed the behaviour, tot_{H1} = total number of birds in hybrid 1at the specific day, and tot_{H2} = total number of birds in hybrid 2 at the specific day. Using this formula the number of birds in hybrid 1 that performed the specific behaviour was adjusted to approximate how many of them would have perched if tot_{H1} had been the same as tot_{H2}. After achieving the o value it was used in a Chi square test (or Yates correlation Chi square test) to calculate significance.
Differences in weight were calculated with two-sided Students T-test.

3.6 Missing values

Some weighing values were lost at the time of calculation. These were: Day 27 one Ross and one Hubbard; Day 34 three Hubbard and two Rowan Ranger; Day 40 one Ross, four Hubbard and three Rowan Ranger; Day 55 two Ross; Day 69 one Hubbard, and Day 75 two Hubbard.

4. RESULTS

4.1 Hybrid Performance

There was a significantly higher mortality rate and slaughter weight in the Ross chickens than in the Hubbard or Rowan Rangers (Tab. 2). There was a notable difference in sex ratios between the hybrids where Rowan Ranger had a surplus of males while Ross had a surplus of females and Hubbard had an approximately equal number of the two sexes (Tab. 2). Hubbard and Rowan Rangers had a very similar average weight across the entire period while the Ross' weight increased faster and was significantly higher at slaughter (Fig. 2).

Tab. 2. Performance and sex ratio of broilers of three hybrids (Ross 308, Rowan Ranger and Hubbard CYJA57). Mortality is calculated on n at the beginning of the experiment (100 per hybrid) while slaughter weight and sex ratio are calculated on birds at slaughter (n: Ross= 80, Rowan Ranger = 98 and Hubbard = 98). a, b, c: P<0,001 significance when compared to Hubbard, Rowan Ranger and Ross respectively.

Hybrid	Mortality (%)	Sex ratio (M/F)	Slaughter mean weight (grams)
Hubbard	2^{c}	1.093	3802 ± 578^{c}
Rowan Ranger	2^{c}	1.280	3793 ± 617^{c}
Ross	$20^{a, b}$	0.860	$6047 \pm 821^{a, b}$

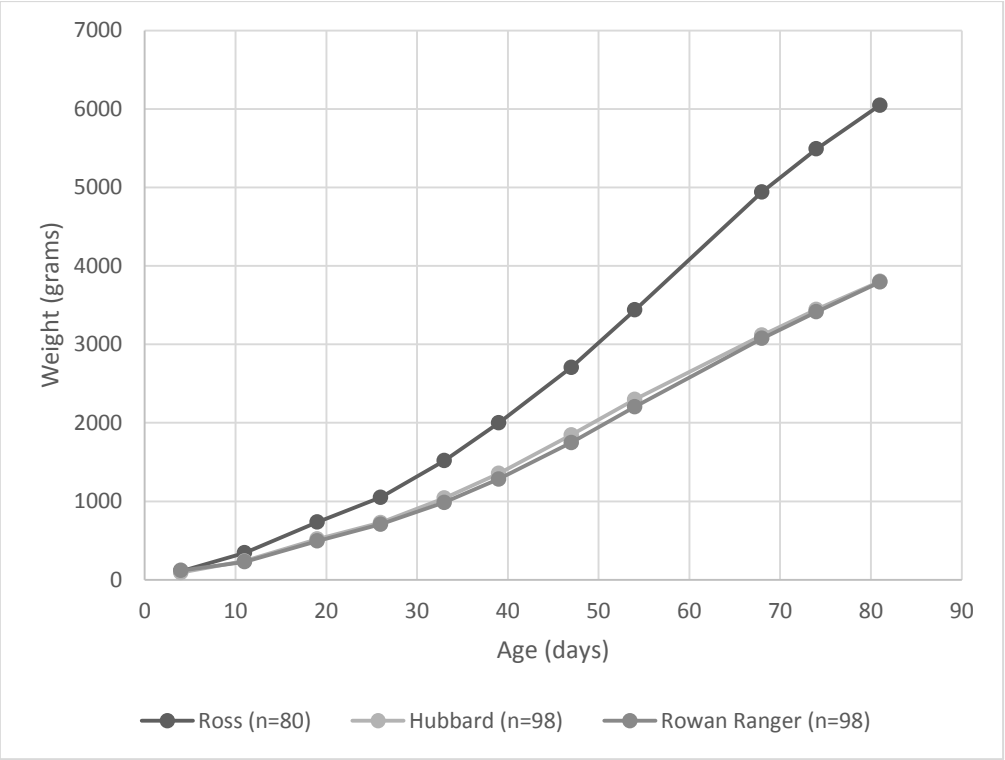

Fig. 2. Mean weight of three broiler hybrids (Ross 308, Hubbard CYJA57 and Rowan Ranger). Only chickens surviving the entire period (82 days) are displayed (starting n: 100 per hybrid). Rowan Ranger birds were not weighed at day 5, as the other chickens were, but rather at day 7 which does not show in the diagram.

4.2 Perching Frequency between Hybrids

Ross chickens perched significantly less than Hubbard and Rowan Rangers during both photophase (Tab. 3) and scotophase (Tab. 4) even though there was no significant difference between the three hybrids in sleeping behaviour during photophase (Tab. 3). The ratio between number of chickens perching and sleeping within hybrid was significantly lower for Ross than for the other two hybrids (Tab. 4). Within hybrids there was no significant difference between perching and non-perching chickens regarding average weight or gender (Tab. 5).

Tab. 3. Number of sleeping and perching birds during photophase group scan observation in a 2x2 m square by three broiler hybrids (Ross 308, Rowan Ranger and Hubbard CYJA57) at different ages. a, b, c: P<0.001 significance when compared to Hubbard, Rowan Ranger and Ross respectively. d, e, f: P<0.01 when compared to Hubbard, Rowan Ranger and Ross respectively. N at day 61 was Hubbard 100, Rowan Ranger 98, Ross 92; n at day 76 was Hubbard 100, Rowan Ranger 98, Ross 83; n at day 80 was Hubbard 98, Rowan Ranger 98, Ross 82. Differences in n between hybrids were eliminated before calculations of p.

	Sleeping (n)			Perching (n)					
Hybrid	Day 61	Day 76	Day 80	Day 61	Day 76	Day 80	Total sleeping	Total perching	Perching/ sleeping ratio
Hubbard	5	13	6	5	6	11^{f}	24	22^{c}	0.917^{c}
Rowan Ranger	12	16	7	6	12^{f}	6	35	24^{c}	0.686^{c}
Ross	8	11	7	1	0^{e}	0^{d}	26	$1^{a,b}$	$0.038^{a,b}$

Tab. 4. Perching behaviour displayed at different heights; low (20 cm), medium (40 cm) and high (70 cm) during scotophase group scan observation of three broiler hybrids (Ross 308, Rowan Ranger and Hubbard CYJA57) at different ages. H/RR= Hubbard and Rowan Ranger. Due to method modifications no perch height data was noted at day 63. a: P<0.05; b: P<0.01; c: P<0.001. Differences in n between hybrids were eliminated before calculations of P.

Day	Hybrid	Low	Medium	High	Total perching	Total birds in hybrid	Ratio perching/total in hybrid
63							
	H/RR	X	X	X	77c	198	0.389[c]
	Ross	X	X	X	11[1]	92	0.120[1]
70							
	H/RR	28[a]	7	8	43[c]	198	0.217[c]
	Ross	3	0	0	3	86	0.035
77							
	H/RR	32[a]	5	25[b]	62[c]	197	0.315[c]
	Ross	3	0	0	3	82	0.037

[1]Significant difference (p<0.05) when compared to Ross Day 70 and Day 77.

Tab. 5. Average weight and sex ratio in three broiler hybrids (n: 10 per hybrid) and their tendency to perch during a focal observation. No significance for P<0.05.

	Perched	Did not perch
Average weight (grams)		
Ross	6060	5753
Rowan Ranger	4180	3814
Hubbard CYJA57	3417	3865
Sex ratio (M/F)	1.2	1.3

4.3 Disturbance during Sleep

There was no significant difference between hybrids in performing disturbing behaviour; however males were significantly more prone than females to disturb other chickens in the focal observations (Tab. 6). Ross chickens were significantly less at risk of being disturbed than Hubbards and there was a tendency for Rowan Rangers being more at risk than Ross chickens (Tab. 6). The two genders seemed to be equally disturbed (Tab. 6).

Tab.6. Disturbance between broilers in a study examining sleeping and perching behaviour (n: 10 per hybrid). Hybrids were Ross 308, Rowan Ranger and Hubbard CYJA57. P<0.05.

Performer	Ross	Rowan Ranger	Hubbard	Total
Female	0	1	2	3
Male	4	4	6	12[1]
Total	4	5	8	17
Recipient				
Female	2	5	6	13
Male	2	6	6	14
Total	4	11	12[2]	27

[1] Significantly different from Female Total.
[2] Significantly different from Ross Total.

5. DISCUSSION

5.1 Hybrid Performance

The purpose of this study was to examine behavioural differences between three broiler hybrids of different growth rate. However, this study did not find any significant difference in growth rate, measured in weight, between Hubbard and Rowan Ranger (medium grower) and Hubbard (predicted to be a slow grower). The Hubbard CYJA57 is a relatively new hybrid (Hardy Eskildsen, Top Æg ApS, personal communication, 29th of February 2016) and it was therefore unclear how the hybrid would fare in this study. In this study no significant difference was found between Hubbard CYJA57 and Rowan Ranger indicating that these two hybrids perform rather similarly.

Regarding mortality, there was a significant difference in survival between the hybrids as 20 % of the Ross chickens died while only 2 % or the other hybrids died. Mortality is a relatively crude measure of welfare since it is very unspecific about how low the experienced welfare is; however, it does show that welfare is impaired in some way (EFSA, 2012), and furthermore it indicates a poor health in the chickens. The fact that 20 % of the Ross chickens died or were culled indicates that the Ross chickens experienced a reduced welfare when compared to the other two hybrids. Furthermore, it is questionable if it would be economically valid to raise broilers when 20 % are lost before slaughter. Thus it is probable that besides reducing welfare in the chickens, housing Ross chickens would also reduce productivity and negatively affect the economy of the broiler producer and this indicates that Ross in an unsuitable hybrid for EU-organic production.

As the chickens in the group scan were not sexed at arrival it is unclear if the skewed gender ratios displayed within hybrids at slaughter is due to gender imbalance in the received batch of chicks or if a specific gender in some hybrids has experienced a higher mortality and therefore is underrepresented in the results. Males are known to reach a higher average slaughter weight than females (Bendheim *et al,* 1992; Horsted *et al.,* 2005; Lumpkins *et al.,* 2008; Closter *et al.,* 2012; Namakparvar *et al.,* 2014) and are associated with a higher risk of death from weight-related diseases like ascites (Bendheim *et al.,* 1992; Closter *et al.,* 2012) although this statement has recently come into question (Namakparvar *et al.,* 2014). Because of this, and due to the findings of Bokkers & Koene (2003) that there appears to be a negative correlation between body weight and perching, sex ratio might affect perching behaviour which has also been proposed by Estevez *et al.*

(2002). If this is the case, the skewed sex ratio in the present study might have affected the hybrid performance in perching behaviour and given a somewhat misrepresenting result. If so, a more balanced sex ratio within hybrids in this study would have led to Ross chickens performing less perching behaviour and Rowan Rangers displaying more perching behaviour than was recorded. However, this would only have affected the results by increasing the already displayed significance between Ross and Rowan Ranger which would further strengthen the results in the present study. Therefore the difference in sex ratio does not negatively affect the credibility of this study.

5.2 Perching

The Hubbard and Rowan Rangers in this study perched significantly more than Ross chickens during both scotophase and photophase even though there was no difference in sleeping behaviour during photophase which demonstrates that Ross chickens to a lesser extent than Rowan Ranger and Hubbards perched when sleeping. Faure & Jones (1982a; 1982b) have previously shown that different strains of layers perch to different extents. Olsson & Keeling (2002) showed that laying hens worked hard to get access to perches and Olsson & Keeling (2000) came to the conclusion that layers experienced reduced welfare when not having access to perches. Bokkers *et al.* (2007) demonstrated that a chicken's physique can affect its ability to execute behaviours it is motivated to perform. In light of these studies it is plausible that the Ross chickens in the present study were motivated but unable to perch because of their physique (Nicol, 2015) as the Ross chickens weighed more than the other two hybrids. Ross chickens were found to perch less at higher age which is consistent with Bizeray *et al.* (2002) and Bailie & O'Connell (2015) who found that perching in Ross 308 declined around week five. However, perching is not fully developed until approximately week six which means that the behaviour should increase with age, not decrease (Nicol, 2015). In red jungle fowl (Arshad & Zakaria, 2009), as well as laying hens (Gunnarsson *et al.*, 2000) chickens continue to perch once they have started, and thus it is not a natural behaviour to cease perching with increasing age. Thereby it is probable that the decline in perching stems from physical inability, and not declining motivation, and consequently this decline results in reduced welfare for the chickens. It is therefore probable that the Ross chickens, regarding perching, had a lower welfare than the Hubbard and Rowan Rangers.

No connection between weight and perching or gender and perching within hybrids was found in the present study. This is contrary to Bokkers & Koene (2003) who found a negative correlation between weight and perching and to Estevez *et al.* (2002) and Faure & Jones (1982a) who demonstrated that females perched more than males, although Faure & Jones (1982b) found no sex difference in perching behaviour in layers. The present study had a low incidence of perching in focal chickens and therefore it is difficult to draw any conclusions from the data in this case. However, due to the inconsistency in the literature, especially since weight might affect conclusions, there is need for further research to see if perching is affected by gender. Future studies should control for weight so this parameter does not affect the results. Studies investigating if perching is affected by weight are also needed and should control for gender. This is important since perching is a natural behaviour (Collias & Collias, 1967; Arshad & Zakaria, 2009) and it is therefore paramount to investigate factors that inhibit broilers from performing natural behaviour. If these studies were to indicate that perching behaviour was correlated with gender this could lead to new measures being taken to ensure that both genders' behavioural needs were met, for example researching if the gender with less perching behaviour needs special perches or

are more in need of ramps to access the perches. If perching behaviour was instead, or also, correlated to weight, this should lead to considerations whether maximum weight limits should be included in the legislation to ensure bird welfare.

In this study Ross chickens were only observed perching on the lowest height while Hubbard and Rowan Rangers perched on all available heights. Since chickens prefer high perches to low (Newberry *et al*., 2001; Schrader & Müller, 2009; Brendler *et al*., 2014) it is probable that the Ross chickens were motivated but not physically able to perch on the high perches in this study. Sanotra *et al.* (2003) found a negative correlation between weight and ability to walk and Corr *et al.* (2003b) discovered that heavier broilers had an altered gait which tired them. It is likely that a chicken with this gait will be reluctant to jump between perches, especially since chickens usually increase stepping behaviour prior to jumping between perches (Scott *et al.,* 1999). In the present study we found that the Ross chickens did not perform perching behaviour to the same extent as the other hybrids and only perched on the lowest perches. Because of this it is probable that the Ross chickens, in regard to perching behaviour, were unable to perform a motivated behaviour and thus experienced reduced welfare in comparison to the other hybrids in this housing.

Further research is needed to show which types of perches are best suited for broilers, or even if there are other forms of look-out posts that broilers prefer. It is not enough to provide all broilers with perches, one has to make sure that the perches are designed in a way that enables the broilers to use them (Keeling, 2004) as the material (Faure & Jones, 1982a; Pickel *et al*., 2010; Chen *et al.,* 2014), inclination (LeVan *et al.,* 2000; Mutaf *et al.,* 2006), shape (Bestman *et al.,* 2011; Chen *et al.,* 2014) and height (Faure & Jones, 1982b; Newberry *et al*., 2001; Estevez *et al.,* 2002; Schrader & Müller, 2009) of the perch influences how much the broilers will use the perch. Therefore it is important to examine how to design the perch to allow for maximum usage.

5.3 Disturbance during Sleep

5.3.1 Performer

In the focal observation the males were significantly more prone to disturb other chickens than were the females. This is a very interesting finding and no scientific papers have been found that investigates this phenomenon. This behaviour did not seem to be agonistic but rather performed by mistake, as the performers of disturbance seemed to not be aware of the chickens they stepped on. As “Comfort around resting” is one of the welfare sub criteria of the Welfare Quality® protocol (Welfare Quality®, 2009) it is probable that being disturbed during sleep would reduce the welfare of sleeping chickens, especially since disturbance during sleep is known to reduce sleeping quality in humans (Smith *et al.,* 2014). Studies have shown that broilers in high density housing rest alongside walls in order to avoid disturbance during rest (Buijs *et al.,* 2010) which shows that disturbance during sleep affects the chickens to a large extent and probably reduces their welfare. In this study, it was not entirely clear why there was a gender difference in disturbance behaviour. The reason might stem from evolutionary differences as males and females have evolved to perform different behaviours. Males vocalise more than females (Bokkers & Koene, 2002) and they also warn other chickens of approaching predators whereas females do not, unless they are broody (Nicol, 2015). Males have been shown to run faster towards a feed treat than females while females run faster towards a conspecific

(Vallortigara *et al.,* 1990) and females prefer being close to known chickens while males spend longer time in the vicinity of unknown chickens (Vallortigara, 1992). In short, behavioural differences based on gender exist, and are due to evolutionary success in past generations. However, the result that performers of disturbance are predominately males is a new finding and needs to be examined further before conclusions can be drawn. Future research should examine not only if disturbing performance is based on gender but also if age and hybrid inherence matter.

There was no significant difference in performers of disturbance between hybrids. There was a tendency for Hubbards to disturb more than Ross chickens but due to the low amount of recordings this is an uncertain result. Sanotra *et al.* (2003) and Bokkers *et al.* (2007) have shown that heavier broilers are less inclined to walk, and Corr *et al.* (2003b) discovered that heavier broilers had an inefficient gait that tired them. This could be the reason for the observed tendency as Ross chickens had a higher average weight and are less active than more slow growing broilers (Wilhelmsson, 2016) and might thereby be less inclined to disturb other chickens. However, this needs to be investigated further before definite conclusions can be drawn.

5.3.2 Recipient

Ross chickens were significantly less prone to be recipients of disturbance during sleep than Hubbards and there was a tendency for Ross to be less disturbed than Rowan Rangers. The reason for this is not known. As Hubbards and Rowan Rangers perched more, and disturbance was performed on the floor, this should have led to Ross chickens being more prone to being disturbed. However, Ross chickens were larger than the other two hybrids and this might have led to other chickens noticing them to a larger extent and therefore avoiding them. This needs to be studied further before assumptions can be made on how hybrids differ in being disturbed and what the cause for this is.

There was no discrimination between genders when examining recipients of disturbance as both genders seemed to be equally affected. This confirms the observation that there was no targeting of specific chickens, but rather that the disturbing bird disturbed chickens that were in its way. If disturbance indeed occurred by chance no gender difference would be found, which these results seem to point towards. However, the present data is limited and therefore it is hard to draw any definite conclusions from it.

5.4 Application of the Present Study

This study can be used as a guideline for broiler producers when choosing what hybrid to house. Further this study can be utilized as a source of information when regulations regarding EU-organic and KRAV broiler production are to be modified. It can also be used as a guideline as to how to apply the EU-legislation (Article 14.1.c.iv in Regulation [EC] No 834/2007 and Article 8.1 in Regulation [EC] No 889/2008) to choice of hybrid, as it states that choice of hybrid in production should strive to prevent animal suffering. The Ross chickens seemed to experience the lowest welfare and should therefore not be kept in EU-organic production.

As the Hubbard CYJA57 is a relatively new hybrid (Hardy Eskildsen, Top Æg ApS, personal communication, 29th of February 2016) the present study brings new insight as to

how this hybrid fares in organic production. This information can be used in future studies when this hybrid is present as well as function as guide for producers when choosing which hybrid to house in their production. In this study, Hubbards performed approximately the same as Rowan Rangers, both physically and behaviourally.

5.5 Strengths and Weaknesses with the Present Study

One of the strengths in this study was the usage of different heights of perches. In this way the study could show not only that the Ross chickens perched significantly less than the other two hybrids, but also that they only perched on the lowest height, thus demonstrating that the Ross chickens might have experienced reduced welfare due to perching behaviour in two ways instead of one. Furthermore, in this study the chickens were provided with more space to perch on than the chickens would occupy if all perched at the same time, thus reducing the risk that competition over perch space affected the results. However, the use of only one type of perch might have affected the results as different hybrids might prefer different perch material, as shown by Faure & Jones (1982a). It is unclear if the perch material utilized in this study favoured any of the hybrids, due to differences in physiology or for other reasons. Furthermore, in this study hatchlings were not sexed upon arrival, only at slaughter, and thus it is unknown if any gender experienced a higher mortality than the other. This would have been interesting to study since males have been shown to perch to a lesser extent than females (Faure & Jones, 1982a; Estevez *et al.* (2002) while they are more susceptible to specific diseases like ascites (Bendheim *et al.*, 1992; Closter *et al.*, 2012), and therefore there exists a risk that the euthanized chickens were not equally divided by gender. Because of this it would have benefited the study if hatchlings had been sexed at arrival.

5.6 Improvement of Animal Welfare

The Swedish Animal Welfare Act (1988:534) states in § 4 that animals are to be kept in a way that allows them to express their natural behaviours, while the Animal Welfare Ordinance (1988:539) § 1b requires that the design of the accommodation shall enable the animals to perform natural behaviours. Perching is a natural behaviour for chickens (Collias & Collias, 1967; Arshad & Zakaria, 2009) and this study has shown that broilers utilize perches when provided access to them. EU-organic legislation states that the housing shall fulfil the behavioural needs of the species (Article 10.3 in Regulation [EC] No 889/2008). Due to the findings of this study broilers should be provided with perches in EU-organic production as it has been demonstrated to be a motivated and natural behaviour in broilers. It is therefore the recommendation that perches should be included in the necessary furnishing needed to house EU-organic broilers.

Article 14.1.c.iv in (EC) No 834/2007 and Article 8.1 in Regulation (EC) No 889/2008 states that when producing EU-organic meat the choice of hybrid must act to minimise animal suffering. This study has demonstrated that out of the three hybrids involved, Ross chickens had a higher mortality, lower occurrence of perching and perched on lower situated perches than Hubbard and Rowan Ranger. Due to these results it is plausible that Ross chickens experienced lower welfare than the two other hybrids and therefore this study concludes that Hubbard CYJA57 and Rowan Ranger are better alternatives to EU-organic housing than Ross 308 and that these two hybrids meet the EU-organic legislation better than Ross.

Perching frequency was relatively low overall when compared to Bokkers & Koene (2003). This might be because of the heating lights, as studies have shown that if chickens do not start perching when young they experience problems when utilizing perches later in life (Gunnarsson *et al.*, 2000). Furthermore, the stocking was low in this study and stocking density is positively correlated with perching behaviour (Pettit-Riley & Estevez, 2001), possibly because the perches help low ranked chickens avoid dominant chickens. However, it is also possible that the chickens in this study did not perch because they did not know how to. Socially facilitated behaviours is common in birds, the most known might be migration but even ground pecking has been shown to be socially facilitated (McQuoid & Galef, 1992). Hens perch together with their chicks (Collias & Collias, 1967), and Riber *et al.* (2007) found that brooded chicks started perching earlier than non-brooded, indicating that perching also is socially facilitated. Because of this it would increase chicken welfare if older hens were housed together with hatchlings in order to help the chickens learn socially facilitated skills, such as perching. Furthermore, a brooding hen increases the occurrence of behavioural synchrony in chicks (Shimmura *et al.*, 2010), which reduces the risk of sleeping disturbance from other chickens since more chickens sleep at the same time. The older hens must of course be individuals that perch themselves.

6. CONCLUSIONS

The aim of this study was to examine perching and sleeping behaviour and how this differed between three hybrids of broiler chicken housed in accordance with EU-organic legislation.

Mortality was higher for Ross chickens than for Hubbards and Rowan Rangers, and this indicated that Ross chickens had a reduced welfare in comparison to the other hybrids.

Compared to Hubbards and Rowan Rangers, Ross chickens were less prone to perch and when perching they utilized only the low perches, whereas Hubbards and Rowan Rangers perched on all three heights. As perching is a natural behaviour and high perches are favoured by chickens it is probable that the Ross chickens experienced a reduced welfare compared to the other hybrids.

There was no significant difference regarding performance of disturbing sleeping chickens between hybrids although Hubbards had a tendency to perform more disturbances than the Ross chickens. This might be due to the heavier weight of the Ross chickens making them less active than the other hybrids, which might be an indication of a reduced welfare of the Ross chickens.

Males were significantly more prone to perform disturbing behaviour than females. As males and females have so different social lives it is possible that this is the reason for the difference between genders.

Ross chickens were significantly less disturbed when sleeping than Hubbards, and there was a tendency for Rowan Rangers to be more disturbed than Ross chickens. This needs to be examined further before conclusions can be drawn on why this occurred.

The results from this study indicate that in EU-organic housing Hubbards and Rowan Rangers experience a higher welfare than Ross chickens and it is therefore recommended that Ross chickens are not chosen for EU-organic broiler production. Furthermore it is the recommendation that EU-organic production includes perches as a furnishing requirement.

7. POPULAR SUMMARY/ POPULÄRVETENSKAPLIG SAMMANFATTNING

Slaktkycklingar utgör över 90 % av alla djur som slaktas för köttproduktion i Sverige. Detta beror på att varje kyckling resulterar i så lite kött; en enda slaktad ko ger lika mycket kött som 217 kycklingar. På grund av detta är det viktigt att gällande lagstiftning ser till att slaktkycklingar hålls på ett acceptabelt sätt.

Dagens slaktkycklingproducenter strävar efter mer snabbväxande kycklingar med större muskler. Detta har dock lett till konsekvenser för kycklingarna som bland annat kan ha svårt att gå eller göra andra beteenden som är viktiga för dem. Dessa problem skiljer sig mellan olika hybrider och därför är det viktigt att undersöka hur beteendena skiljer sig mellan hybrider för att kunna uppskatta vilka hybrider som mår bättre och därmed ska prioriteras inom produktionen. På grund av detta undersökte denna studie om hybrider skiljde sig åt vad gäller sömnkvalitet genom att undersöka sömnsittpinneanvändning, vilket är ett viktigt beteende för kycklingar, och om kycklingarna inom någon hybrid var mer benägen att störa andra sovande kycklingar.

Totalt 300 kycklingar från hybriderna Ross 308 (snabbväxande), Rowan Ranger (medelväxande) och Hubbard CYJA57 (långsamväxande) hölls tillsammans under EU-ekologiska förhållanden med tillgång till sittpinnar i tre olika höjder. Kycklingarna studerades såväl på dagen som på natten. Rosskycklingarna visade sig sitta mindre på pinne än de andra två hybriderna, och de använde dessutom bara de lägsta pinnarna medan Hubbard- och Rowan Rangerkycklingarna använde sittpinnar på alla höjder. Vad gäller störning av sovande kycklingar fanns det inte någon tydlig skillnad mellan hybrider men Hubbardkycklingarna var aningen mer benägna att störa andra kycklingar än Rosskycklingarna. En intressant upptäckt var dock att hannarna störde andra kycklingar mer än vad honorna gjorde. Rosskycklingarna blev mer sällan störda när de sov än de andra hybriderna.

Baserat på de resultat som framkom i studien verkar det som att Ross 308-kycklingar mår sämre än Hubbard CYJA57 och Rowan Rangerkycklingar och studiens slutsats är därför att det är bättre att använda Hubbard eller Rowan Rangerkycklingar i EU-ekologisk slaktkycklingproduktion.

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